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Happer et al.

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(54) **METHOD AND SYSTEM FOR OPERATING A LASER SELF-MODULATED AT ALKALI-METAL ATOM HYPERFINE FREQUENCY**

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This patent is subject to a terminal disclaimer.

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(58) **Field of Classification Search** **331/3, 331/94.1**

See application file for complete search history.

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(57) **ABSTRACT**

The present invention provides a method and apparatus for making atomic clocks or atomic magnetometers as self-modulated laser systems based on the physics of push-pull optical pumping. An atomic vapor cell is required to be in the laser cavity. With proper conditions, spontaneous push-pull optical pumping can occur inside the laser cavity. This causes the laser beam to be modulated at hyperfine-resonance frequency. With a fast photodetector, the modulated laser signal can be converted into the electrical signal, which serves as the atomic clock ticking signal or magnetometer signal. The self-modulated laser system does not use any local oscillator and the microwave circuit to lock the oscillator frequency to the hyperfine-resonance frequency, and therefore can consume less power and become more compact than conventional systems. This invention will benefit applications of time measurements and magnetic-field measurements.

52 Claims, 12 Drawing Sheets

